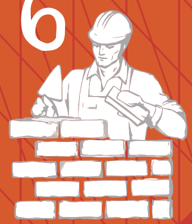
Unit 6



Building Drawing

Before constructing any building, detail designing of all the components are made on paper and then transmitted into drawing. Drawings are made on paper as per the standard procedure. This drawing helps workers, engineers and users in understanding and planning the construction work.

Session 1: Basic Geometric Constructions

The understanding of plane geometry is pre-requisite for the proper use of geometric constructions. The students, during making geometric constructions develop skills in handling drawing tools (compasses and dividers, triangles, rulers, templates) and promote logical thinking. Engineering drawing consists of many such geometrical constructions. To record information on paper or any other surface, instruments and equipment are needed, since engineering drawing is a representation of the graphical language.

List of essential instruments and equipment for geometrical constructions and drawing

1. Drawing board and stand
2. Tee-square

3. Mini drafter
4. Set square
5. Protractor
6. Instrument box
7. French curves or irregular curves
8. Pencil
9. Eraser and erasing shield
10. Blade, pocket knife, or pencil sharpener
11. Drawing pins, adhesive tape, or clips
12. Drawing paper or drawing sheet, tracing paper, and tracing cloth
13. Cloth or brush for dusting
14. Sand paper
15. Scales (engineering scales)
16. Sketch book

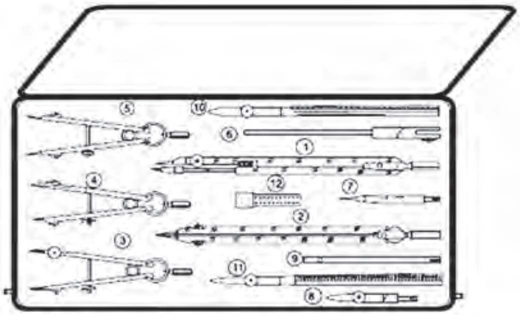


Fig.6.1: Drawing an Instrument box

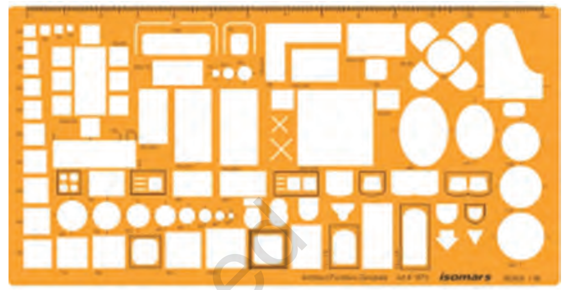


Fig.6.2: Template

You must have used some of the above instruments in your earlier classes but the important ones are shown in Fig.6.1.

1. Large size compass (150 mm long) with inter-changeable legs for pen or pencil
2. Large size divider (150 mm long)
3. Small bow compass (95 mm long)
4. Small ink bow compass (95 mm long)
5. Small bow divider (95 mm long)
6. Lengthening bar
7. Pin point
8. Ink point
9. Ruling pen or liner

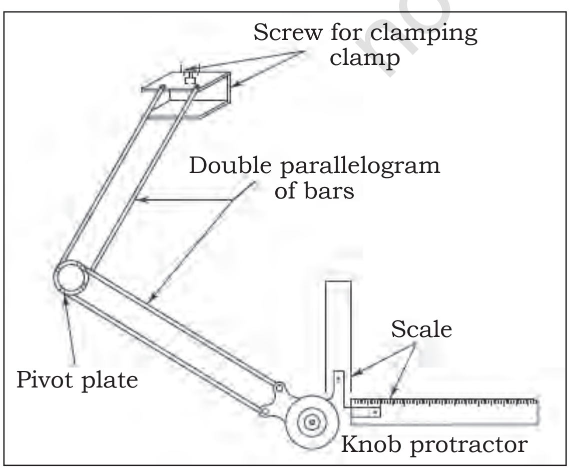


Fig.6.3: Mini drafter

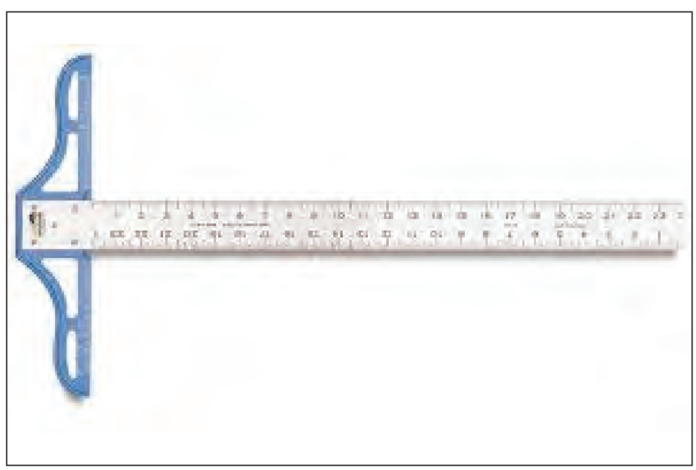


Fig.6.4: Tee-square

10. Holder croquill (for lines)
11. Lead case (for storing lead)

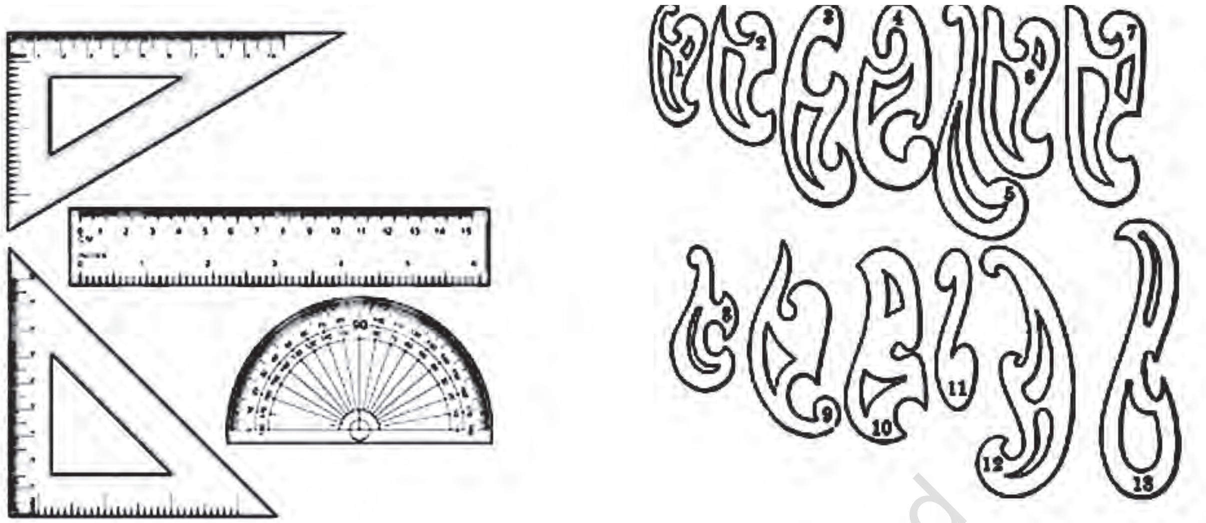


Fig. 6.5: Set squares, scale, protractor and set of French curves

Methods of Geometrical Constructions

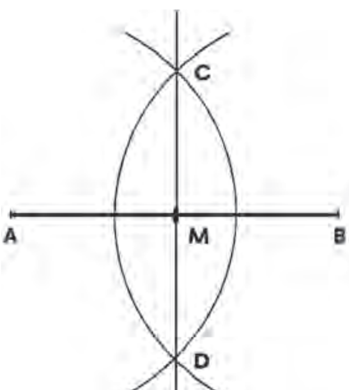


Fig.6.6: Bisecting a line

Problem 1

Bisect a given segment of a line AB.

Solution: (Fig.6.6)

1. Using a scale or ruler, draw a line AB of given length.
2. Set a compass more than half the length of AB, and using A as the centre draw arcs as shown in the figure.
3. Draw arcs using B as the centre with the compass set as above.
4. Connect the intersection (C and D) by a line.
5. The connecting line bisects AB in point M.

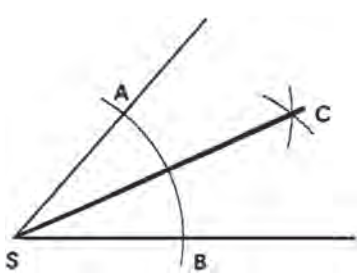


Fig.6.7: Bisecting an angle

Problem 2

Bisect a given angle.

Solution: (Fig. 6.7)

1. Draw any acute angle.
2. To obtain points A and B on the lines, draw an arc with S as the centre.
3. Using A and B as the centres draw arcs which intersects on point C
4. The connecting line C-S bisects the angle.

Problem 3

Constructing an angle of 60°.

Solution (Fig.6.8)

1. Using a scale or ruler draw a straight line and mark point A on it as shown in the figure.
2. Open compass to a suitable length, place needle of the compass on point A and draw an arc, thus intersecting the line at point B.
3. Keeping the compass opening same, place the compass needle on point B and draw an arc intersecting the previous arc at point C.
4. Join AC. Angle BAC is required angle of 60°.

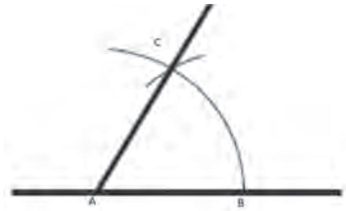


Fig.6.8: Constructing an angle of 60°

Problem 4

Constructing an angle of 30°.

Solution (Fig.6.9)

1. Construct an angle ABC of 60°.
2. Open a compass; draw an arc by placing the compass needle at point C. Similarly draw an arc by placing the needle at the point B thus intersecting the arc at point D.
3. Join AD, Angle DAB is of 30°, i.e. half of 60°.

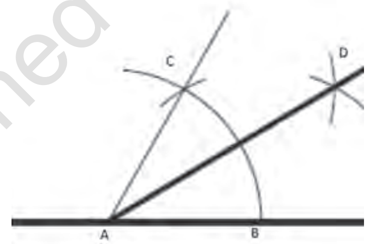


Fig.6.9: Constructing an angle of 30°

Problem 5

Constructing an angle of 90°.

Solution (Fig.6.10)

1. Using, scale or rulers, draw a straight line. Mark point A on it.
2. Open compass to a suitable length, place the compass needle at point A and draw an arc intersecting the line at point B. Do not change the opening of compass for the next steps.
3. By placing the needle at point B intersect the arc at point C.
4. Similarly, place the compass needle at point C, intersect the arc at point D.
5. Taking centre C and D draw arcs intersecting at point E. Join AE.
6. Angle BAE is of 90°.

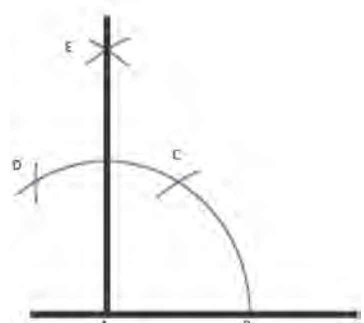


Fig.6.10: Constructing an angle of 90°

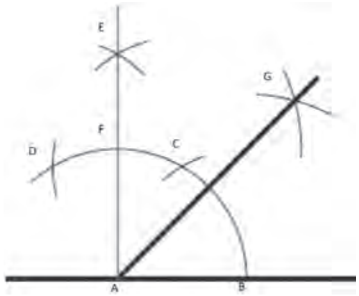


Fig.6.11: Constructing an angle of 45°

Problem 6

Constructing an angle of 45°.

Solution (Fig.6.11)

1. Construct an angle BAE of 90°.
2. Open a compass and with centre point as B and F, draw arcs intersecting at point G.
3. Join AG. Angle BAG is of 45°.
4. It is bisector of 90° angle.

Problem 7

Draw a perpendicular line to the line AB at point A.

Solution: (Fig.6.12)

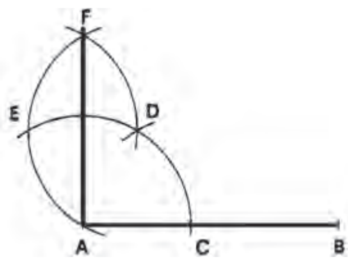


Fig.6.12: Drawing a perpendicular to a given line

1. Using a scale draw a line AB. The perpendicular to this line is to be drawn at point A.
2. Set the compass to any radius and do not change it in further steps.
3. Draw an arc about A as centre, thus obtain a point C on the line AB.
4. Draw an arc about C as centre, thus obtain point D.
5. Draw an arc an arc about D as centre, thus obtain point E and it also touch line at point A.
6. Draw an arc about E as centre, thus obtain point F.
7. Connecting line F to A is the perpendicular.

Problem 8

Divide a given line into 5 equal parts.

Solution: (Fig.6.13)

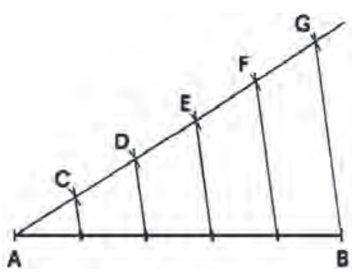


Fig.6.13: Dividing a given line in equal parts

1. Using a scale draw a line AB. This line is to be divided into equal parts.
2. From A of this line draw a second line at any convenient angle.
3. Open a compass to suitable length and divide the second line into 5 equal spaces (points C–G) without altering the compass opening.
4. Connect G with B.
5. Using set squares draw parallel lines to GB from all the points (points F-C) as shown in the figure.
6. Thus the line AB gets divided into 5 equal parts.

Problem 9

Drawing parallel lines by compass.

Solution (Fig.6.14)

1. Using a scale draw a straight line AB and extend it to both sides.
2. Open compass to a desirable length, place the compass needle at point A on the line and draw an arc as shown in the figure.
3. Do not alter the compass opening and draw similar arc from the point B on the line.
4. Mark the highest points on the arcs as C and D.
5. By using scale or ruler, join points C and D and extend the line to both sides. The line CD thus obtained by joining the points is parallel to the line AB.
6. In case the parallel line is to be drawn which passes through the point C, then draw perpendicular from point C to the line meeting at A. Set compass opening equal to the length of perpendicular CA, draw an arc from the point B and mark highest point or point of tangency on the arc D and join CD. Alternatively a perpendicular can be drawn from point B and cut this perpendicular to same length as CA to obtain point D.

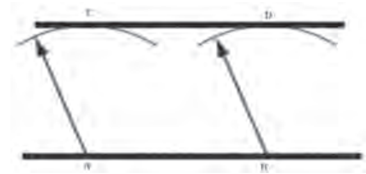


Fig.6.14: Drawing parallel lines

The Triangle

Definitions

A plane figure surrounded by three straight sides forms a triangle.

- A scalene triangle is formed by three unequal sides and three unequal angles.
- An isosceles triangle is a made by two equal sides, and hence two equal angles.
- An equilateral triangle is formed by the equal sides and equal angles.
- A right-angled triangle has only one right angle in a triangle. The side opposite to the right angle is known as the ‘ hypotenuse’.

Problem 10

Construct an equilateral triangle, if one of the sides is given.

Solution: (Fig.6.15)

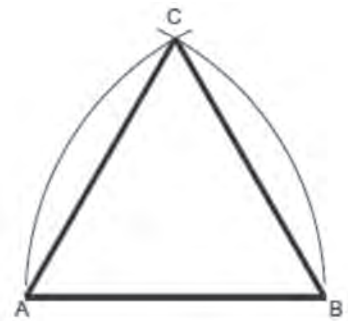


Fig.6.15: Drawing equilateral triangle

1. Using a scale draw a line AB equal to the given length of the side.
2. Place compass needle at point A and open it to the radius equal the length of side AB and draw an arc as shown in the figure.
3. Similarly place the compass needle point on B, and without changing the radius, draw another arc to cut the first arc at point C.
4. Join AC and BC. Triangle ABC is an equilateral triangle.

Problem 11

Construct an isosceles triangle.

Solution (Fig.6.16)

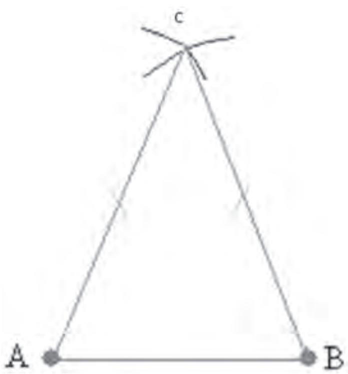


Fig.6.16: Drawing isosceles triangle

1. Using a scale draw a line AB to a given length.
2. Open a compass more than the length of AB, place the compass needle at point A and draw an arc as shown in figure.
3. Keeping the same compass opening, again place the compass needle at point B and draw an arc, and intersect the previous arc at point C.
4. Join AC and BC.
5. ABC is the isosceles triangle in which AC=BC

Problem 12

Construct a scalene triangle with side lengths as 6cm, 5cm and 4cm, respectively.

Solution (Fig.6.17)

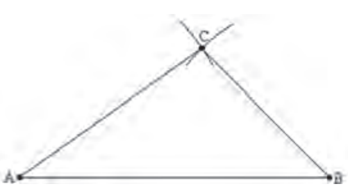


Fig.6.17: Drawing scalene triangle

1. Using a scale draw a 6cm line. Mark one of the end as A and the other B as shown in the figure.
2. Set the compass to a radius of 5cm which will be equal to the second side of the triangle.

3. Place the compass needle at point A and draw an arc above the line.
4. Set the compass to a radius of 4cm which will be equal to the third side of the triangle.
5. Place the compass needle at point B and draw an arc above it so as to intersect the previous arc at point C.
6. Join AC and BC to form a triangle ABC.

The Quadrilateral

Definitions

A figure bounded by four straight sides is called quadrilateral.

- A quadrilateral having four sides of equal length and all the four angles as right angle is called square.
- A quadrilateral with its opposite sides of equal length and all the four angles as right angle is called rectangle.
- A quadrilateral with its opposite sides of equal length and parallel is called parallelogram.
- A quadrilateral with all four equal sides iscalled rhombus.
- A quadrilateral with one pair of opposite sides as parallel is called trapezium.
- A quadrilateral having all unequal four sides and angles is known as trapezoid.

Problem 13

Construct a square, the length of the side is given.

Solution: (Fig.6.18)

1. Using a scale draw the side BA equal to the given length.
2. Make an angle of 90 degrees or erect a perpendicular from point B.
3. Mark the point C on the perpendicular line so that line BC is equal to the line BA equal to the given length.
4. Open the compass equal to the length of the side of the square, with needle point at A and C, draw arcs to intersect at point D.

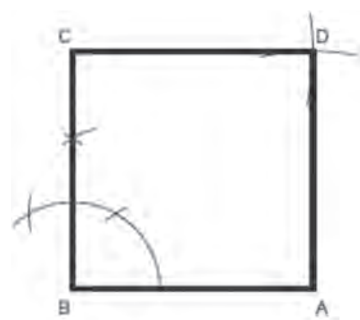


Fig.6.18: Drawing a square

5. Join CD and AD. Thus, the quadrilateral ABCD formed is the required square having all the sides equal and all the angles as right angles.

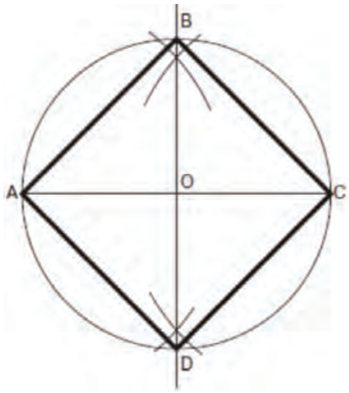


Fig.6.19: Drawing a square given diagonal

Problem 14

Construct a square, the length of diagonal given.

Solution: (Fig.6.19)

1. Using a scale draw a diagonal AC equal to a given length.
2. Bisect AC so that O is midpoint of the diagonal. Extend the bisecting line.
3. Set the compass to radius OA (OC) and with needle point at centre O, draw a circle so as to cut the bisecting line at point B and D respectively as shown in figure.
4. With the help of a scale join the points on the circle and form the quadrilateral ABCD.
5. Therefore, the quadrilateral ABCD is the required square.

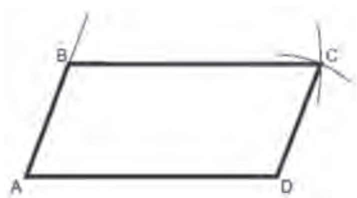


Fig.6.20: Drawing a parallelogram

Problem 15

Construct a parallelogram, of which two sides and an angle are given.

Solution: (Fig.6.20)

1. Using a scale draw AD equal to the length of one of the given sides.
2. With the help of a protractor construct the known angle at point A and extend the angle line.
3. Using a compass or scale mark off AB equal in length to the other given side.
4. Open the compass equal in radius to AD and with compass needle at point B draw an arc.
5. Open the compass equal in radius to AB and with compass needle at D, draw an arc equal in radius to AB which intersects the previous arc at point C.
6. Join point B with C and point C with D. Thus ABCD is the required parallelogram.

Problem 16

Construct a trapezium, given lengths of the parallel sides, the perpendicular distance between parallel and one angle.

Solution: (Fig.6.21)

1. Using scale or ruler draw AB equal to the length of one of the parallel sides.
2. Open the compass equal to the given perpendicular distance, construct the parallel line by drawing arcs from point B and A, respectively.
3. From point B construct the given angle so as to intersect the, parallel line in point C.
4. From point C mark off the other given length of parallel side equal to CD. Join DA.
5. Therefore ABCD is the required trapezium.

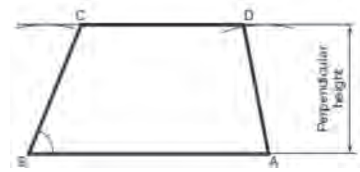


Fig.6.21: Drawing a trapezium

Problem 17

Construct a rhombus when the diagonal and the length of the sides is given.

Solution: (Fig.6.22)

1. Using a scale draw the line AC equal to the diagonal.
2. Open compass equal in length to the sides and from points A and C draw intersecting arcs, which intersects at points B and D respectively.
3. Join AB, BC, CD, and DA.
4. Thus, ABCD is the desired trapezium.

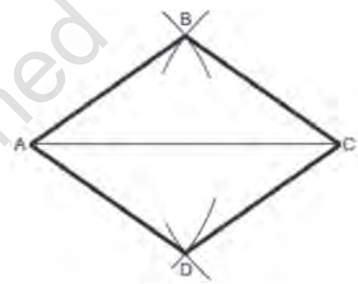


Fig.6.22: Drawing a rhombus

Polygons

Definitions

A plane figure bounded by more than four straight sides is called a polygon.

- A plane figure bounded by five sides is called a pentagon.
- A plane figure bounded by six sides is called an hexagon.
- A plane figure bounded by seven sides is called an heptagon.
- A plane figure bounded by eight sides is called an octagon.

- A plane figure bounded by nine sides is called an nonagon
- A plane figure bounded by ten sides is called a decagon.

If all sides of polygon are equal it is called a regular polygon. Therefore, the regular polygon will have all its exterior angles equal and also all interior angles equal.

Problem 18

Construct a hexagon; the length of the sides is given.

Solution: (Fig.6.23)

1. Open the compass to a radius equal to the length of the side and draw a circle,
2. Do not change the opening of the compass, take any point on the circumference of the circle and mark the radius around the circle six times. You will finish exactly at the same point on the circumference where you started if the construction is accurate.
3. Using a scale join the six points to form a regular hexagon as shown in the figure.

Fig.6.23: Drawing a hexagon

Problem 19

Construct any regular polygon; the length of a side is given.

Solution: Method 1 (Fig.6.24)

1. Using a scale draw a line AB equal in length to one of the given sides. Extend the line AB to a point P.
2. The exterior angle of the polygon is calculated dividing 360° by the number of sides of the polygon. In this case regular polygon is a heptagon, therefore the exterior angle is 360° /7.
3. At point B draw the exterior angle PBC. Mark off BC equal to AB.
4. Bisect the lines AB and BC. The bisectors intersect in point O as shown in the figure.
5. Open the compass equal to radius OA (OB = OC) and with centre O draw a circle.

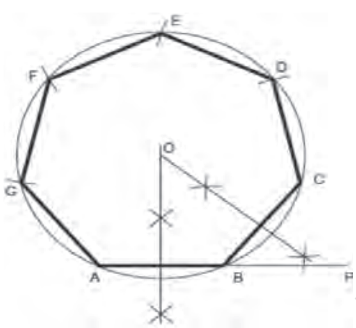


Fig.6.24: Drawing a polygon

6. Mark off the sides of the figure with the compass opening it equal to the side of the polygon from C to D, D to E, E to F, and F to G.
7. Join the points on the circumference and ABCDEFG is the required heptagon.

Solution: Mehod-2 (Fig.6.25)

1. Using a scale draw a line AB equal in length to one of the given sides. Extend the line from the point A.
2. Open the compass equal to radius AB, with needle point at A draw a semi-circle so as to meet the extended line BA at point P.
3. Divide the semi-circle into equal parts. The number of parts should be equal to the number of sides of polygon. This may be done by calculation (180° /7 for each arc) since in the example the regular polygon is heptagon.
4. Using a scale draw a line from point A to point 2 (for all polygons). This line thus forms a second side of the polygon.
5. Using a compass, bisect the lines AB and A 2 to intersect in point O as shown in the figure.
6. Open the compass equal to radius OB (OA= O2) and with centre O draw a circle.
7. Mark off the sides of the figure with compass opening equal to the side of the polygon from B to C, C to D, D to E, E to F, and F to G.
8. Join the points on the circumference and ABCDEFG is the required heptagon.

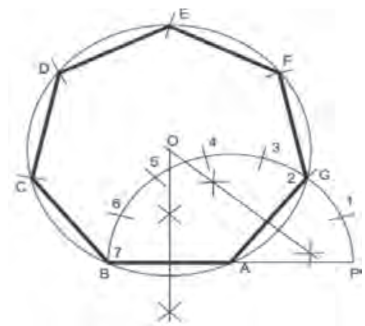


Fig.6.25: Drawing a polygon

Problem 20

Construct any regular polygon; the length of a side is given or general method of drawing any regular polygon.

Solution: Mehod-3 (Fig.6.26)

1. Using a scale draw a line AB equal to the given length of polygon.

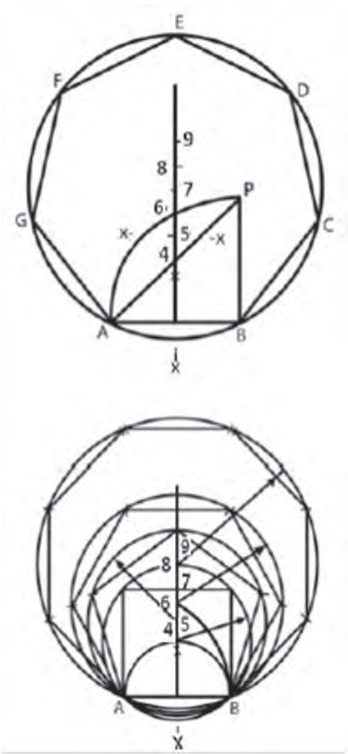


Fig.6.26: Drawing polygon

2. At point B of the line, draw a perpendicular BP and mark it off equal to AB the length of the side of polygon.
3. Join point A with point P to form straight line AP.
4. Open the compass equal to radius AB and with centre B draw an arc AP.
5. Draw the perpendicular bisector on the line AB and extend it so as to meet the straight line AP and arc AP in points 4 and 6 respectively.
6. Using a compass bisect the distance between point 4 and 6 in order to get the point 5.
7. Adjust the compass to radii as 4B, 5B and 6B and draw circles with centres as point 4, 5 and 6 and inscribe a square, pentagon and hexagon in the respective circles.
8. For inscribing heptagon and octagon, etc; and their respective circles, mark centre point 7, 8, etc; with 6-7,7-8,etc; equal to the distance 4-5 as shown in the figure.

Practical Activity

1. Make a list and poster showing important drawing instruments (freehand sketches) used for geometric constructions.

S.No.	Instruments used

Check Your Progress

A. Fill in the blanks

1. The understanding of plane geometry is pre-requisite for the proper use of ______________.
2. A plane figure surrounded by ______________ forms a triangle.
3. A scalene triangle is formed by three ______________ sides and three ______________.

4. A figure bounded by _____________ sides is called quadrilateral.
5. A quadrilateral with all _____________ sides is called rhombus.
6. A plane figure bounded by more than _____________ sides is called a polygon.
7. A plane figure bounded by _____________ sides is called heptagon.
8. A plane figure bounded by _____________ sides is called decagon.

B. State whether the following statements are true or false.

1. Bisecting the line means dividing the line into two equal parts.
2. If one line is perpendicular to another line, they intersect each other at 45°.
3. A triangle having all the three sides equal is called equilateral triangle.
4. A plane figure with more than five sides is called quadrilateral.
5. A quadrilateral with all four equal sides is called rhombus.
6. A quadrilateral with one pair of opposite sides parallel is called trapezium.
7. A plane figure bounded by eight sides is known as heptagon.
8. A plane figure bounded by nine sides is called nonagon.

C. Answer the following questions

1. Why geometric constructions important in making drawing?
2. Divide a straight line into seven equal parts.
3. List the steps making polygon having 10 equal sides.
4. Drawing tangents from a given point lying on the diameter of circle to the circle.

Session 2: Tools of Engineering Drawing

Engineering Drawing

A drawing is a graphical representation of a real object. Engineer express ideas on a paper through the medium of drawing. The use of a drawing is to explain the shape and size of a particular object by means of lines.

For understanding a drawing, knowledge of the standard conventions, basic symbols and rules used on the different types of drawings is required.

Notes

Drawing Scale

A scale is used to draw and represent the actual size of real-life objects, such as the real size of a car, an airplane, for this we need drawings scale to represent the size like the one you see in Fig.6.27 of a van.

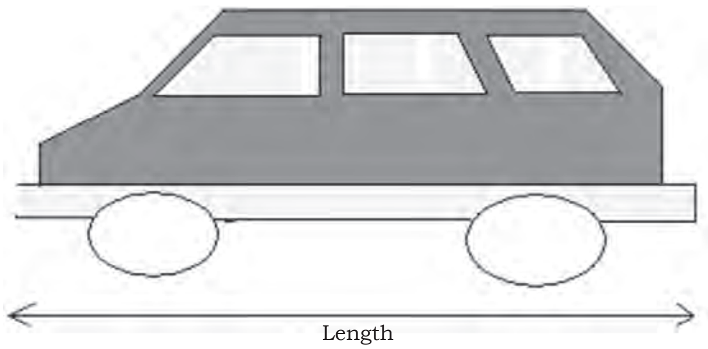


Fig.6.27: Drawing scale

In real life, the length of this van may measure 6000 mm. It is suggested that, the length of print paper that one may use to draw this van should be a little bit less than 300 mm.

Since 6000/300 = 20, you will need about 20 sheets of copy paper to draw the length of the actual size of the van. In order to use just one sheet, you may use 1 mm on your drawing to represent 20 mm on the real-life object. We can write this situation as 1:20 or 1/20 or 1 to 20.

It may be noted that the first number always refers to the length of the drawing on paper and the second number refers to the length of the actual object.

The drawing scale is also called representative fraction (RF). It shows instantly the ratio of the size of the line on the drawing and the actual size. It can be said, that the ratio of numerator to denominator of the fraction is the ratio of drawn size to natural size of an object. RF of 1/20 means that the actual size of the object is twenty times of the size of the drawing of same object.

The scale of 1:1 (read as one-to-one) shows the object has been drawn to true size. A scale of say 2:1 (read as two-to-one) informs that the object has been enlarged twice its true size in the drawing. A scale of 1:2 (read as one-to-two) shows that the object has been reduced to its half size, etc.

Dimensions of Drawing Sheets

The common paper sizes for technical drawings are known as A-FORMATS. In the A-Format series, the largest size is A0. The size of an A1 paper is half the

size of A0 while A2 is half the size of A1 and so forth. Higher order paper size (which is always smaller in size) is obtained by simply halving the preceding size along its longer side. Size of A4 is found to be the smallest paper size in technical drawings. The A format paper sizes are shown below:

Designation	Dimensions in mm
A0	841 × 1189
A1	594 × 841
A2	420 × 594
A3	297 × 420
A4	210 × 297

Basic Line Types

The basis of any drawing is a line. The use of a right type of line make a correct drawing. Table shows some basic types and thickness of lines used for various purposes (for more lines refer to BIS). Each line represents a definite aim and it should not represent anything else.

Type of lines	Appearance	Name according to application
Continuous thick line		Visible line
Continuous thin line		Dimension line Extension line Leader line
Dash thick		Hidden line
Chain thin line		Centre line
Continuous thin wavy		Short break lines or irregular boundary lines – drawn freehand
Continuous thin with zig-zag		Long break lines
Short dashes gap 1, length 3 mm		Invisible or interior surfaces lines
Long chain thick at end and thin elsewhere		Cutting plane lines

Meaning of Lines

Visible or object lines represent features that can be seen in the current view.

Hidden lines explains the features which are not seen in the current view.
Center line explains symmetry, axis of symmetrical parts, centers of circles, path of motion.
Dimension, leader and extension lines shows the sizes and location of items on a drawing.
Cutting plane lines explains the place of an unreal cut which has been done, so that the interior of the item can be seen.

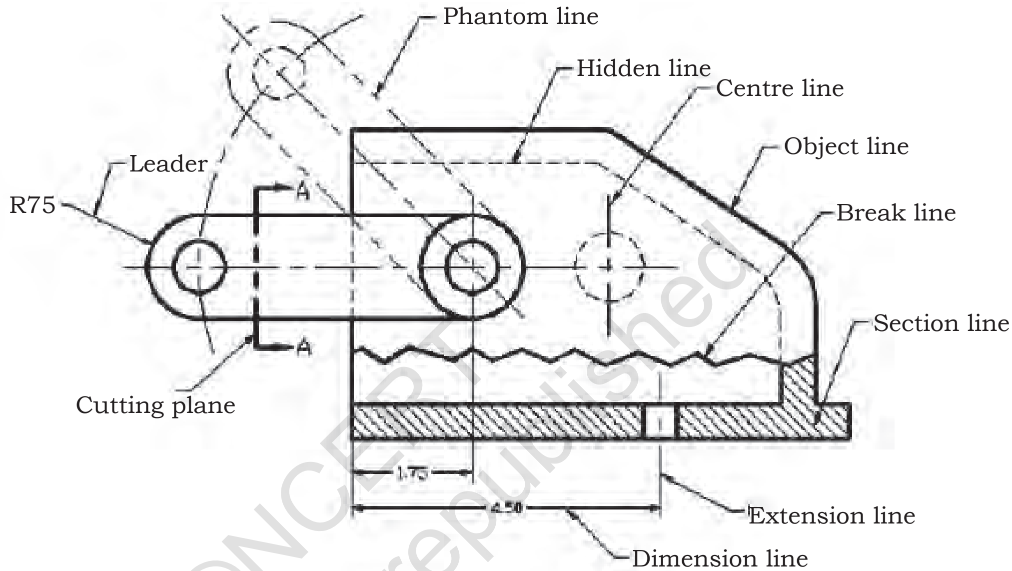


Fig.6.28: Line conventions in engineering drawing

Phantom lines indicate or show imaginary features, such as a moving position of a part.
Break lines explain imaginary cut where the interior of the object can be viewed.
Example: Line conventions in engineering drawing (Fig.6.28)

Projections

A projection is view considered to be drawn onto a plane, called as the plane of projection. Orthographic or multiview projections is made from an object developed by projectors from the object perpendicular to the planes of projection.

The concept of projection is used to display 3-D objects on 2-D media (paper, computer) graphically. The projection theory is based on line of sight and plane of projection.

Line of sight is an imaginary line of light between an observer's eye and an object.

Isometric projection

In isometric projection, all dimensions with the three axes are drawn to true size. Isometric projection is made when the three views of the object are seen for accurate presentation of the object.

The main advantage of isometric drawing is that it is easy to understand and the disadvantage includes the distortion in shape and angles as shown in Fig.6.29.

Orthographic Projections

In this projections, an object is presented in a unique way where more views are required. It is a parallel projection technique in which the parallel lines of sight are drawn perpendicular to the projection plane as shown in Fig.6.30. The number of views needed should be sufficient to represent the object completely and

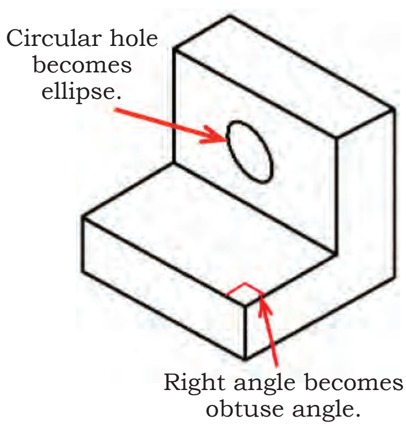


Fig.6.29: Shape and angle distortion in isometric drawing

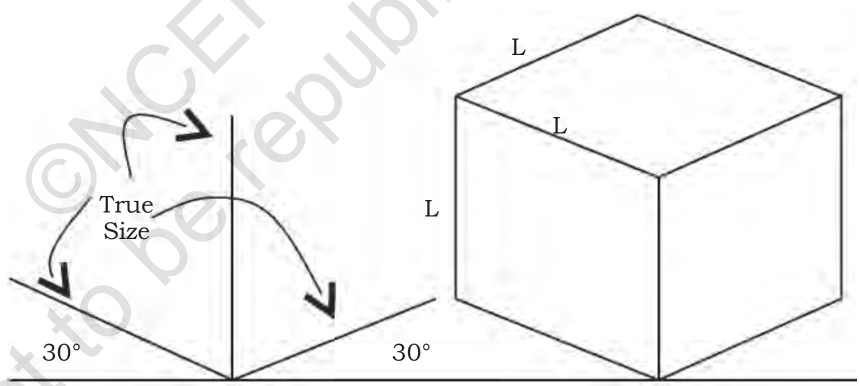


Fig.6.30: Isometric projection

conveniently, but it should be kept to the minimum. For all purposes, three views are completely sufficient.

- Engineering drawings usually prefer orthographic views rather than pictorial views.
- Orthographic views makes the record the shapes of an item correctly and completely.
- Orthographic view is a two-dimensional (2-D) drawing. It shows only one side of an object and two of its overall dimensions.
- A minimum of two orthographic views are required

to show the three dimensions of any object and therefore to describe its shape completely.

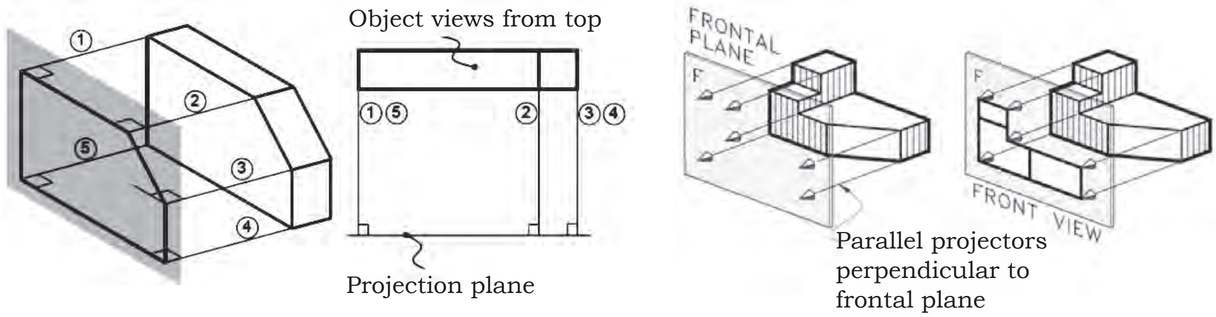


Fig.6.31: Orthographic projection

Some features of the object that do not directly appear on viewing the object from any specific direction (known as hidden details) are shown on the drawing as dotted lines.

Standard Orthographic Projections

Two standards are commonly in use in orthographic projection of drawings — the First Angle Projection and the Third Angle Projection. It should be noted that corresponding views are identical in both methods of projection except for their relative positions on the drawing paper.

The First Angle Projection

In here, the front view is the basis (reference) and the other views are drawn as 'shadows' of that view. That is, the left hand side view for instance is drawn on the right side of the front view. Similarly, the top view (plan) is drawn at the bottom of the front view, etc.

The Third Angle Projection

In here, the front view is the basis (just as before) but the other views are drawn as 'reflections' of that view. The left hand side view is drawn on the left hand side of the front view. Similarly, the top view (plan) is drawn at the top of the front view. The symbols for first and third angle projections are shown in Fig.6.32.

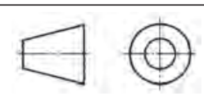
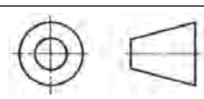
Projection	Symbol
First angle	
Third angle	

Fig.6.32: The symbols used for first angle and third angle projections used in engineering drawings.

Example: First angle projection

In first-angle projection, the item or object is kept in

front of the image planes, and the views are created by projecting to the image plane situated at the back.

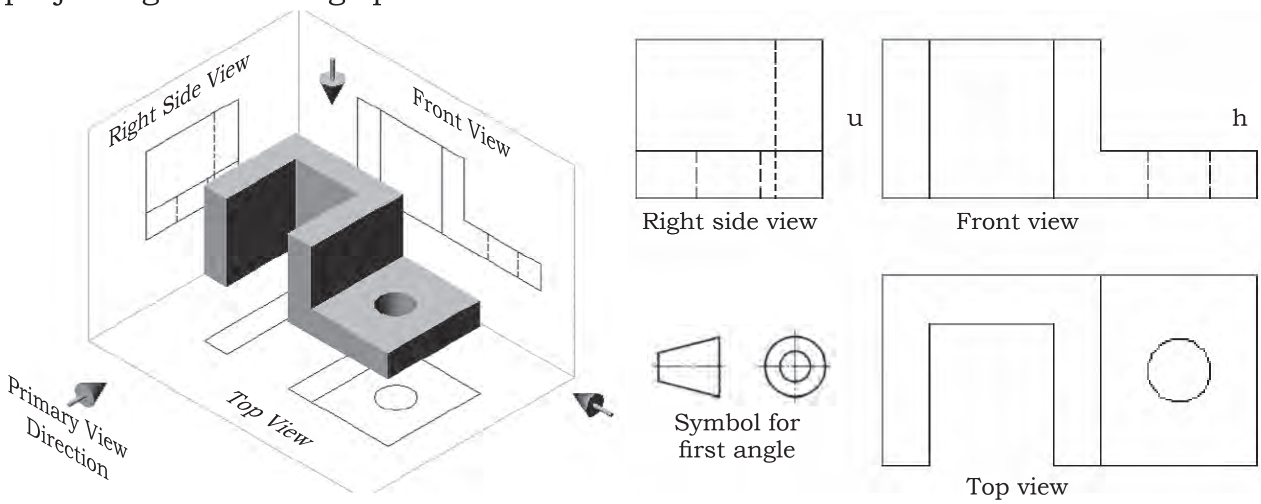


Fig.6.33: First angle projection

Example: Third angle projection

In third-angle projection, the image planes are kept in between the object and the observer. The views are created by projecting the image plane in front of the object.

Dimensioning

For making of machine components, all the relevant dimensions should be shown on the drawing. The practice is that any dimension is shown only once in that view in which it appears more explicitly. For this reason all the main dimensions are kept in the front view. Repetitions are avoided if not necessary. To keep the drawing clean, it is advised to put all the dimensions outside the drawing, except where and when this is unavoidable.

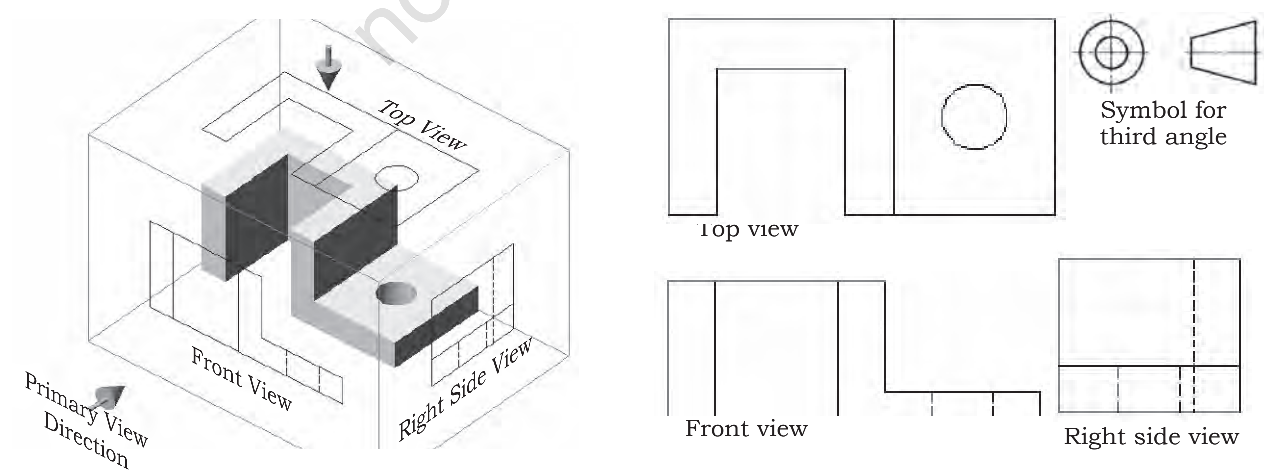


Fig.6.34: Third angle projection

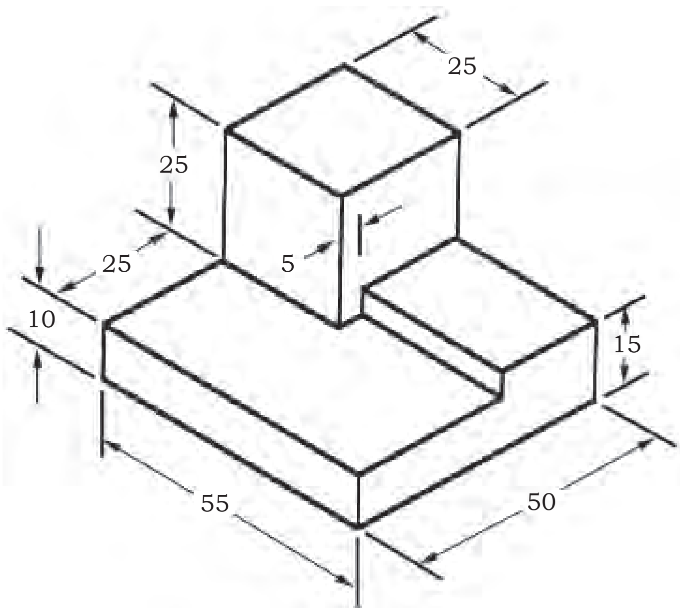


Fig.6.35: Dimensioning of the object

The dimensioning of the object of the isometric drawing is shown in Fig.6.35. As a thumb rule for dimensioning, make an object and dimension in the proper useful way. Dimensions should be drawn completely as per needs by the draftsman or technician.

Repeatedly measurement from one point to another point may lead to inaccuracies. It is always appropriate to measure dimensions from one end to other points. It is useful to choose the placement of the dimension in the order so that machinist would develop the part of product easily.

General Hints on Dimensioning

- Use common sense as per need and depend on circumstances.
- All linear dimensions are considered to be in millimetre in metric system.
- Show full size dimensions regardless of the scale used in the drawing.
- Dimension in a manner that makes it unnecessary to calculate any required size information.

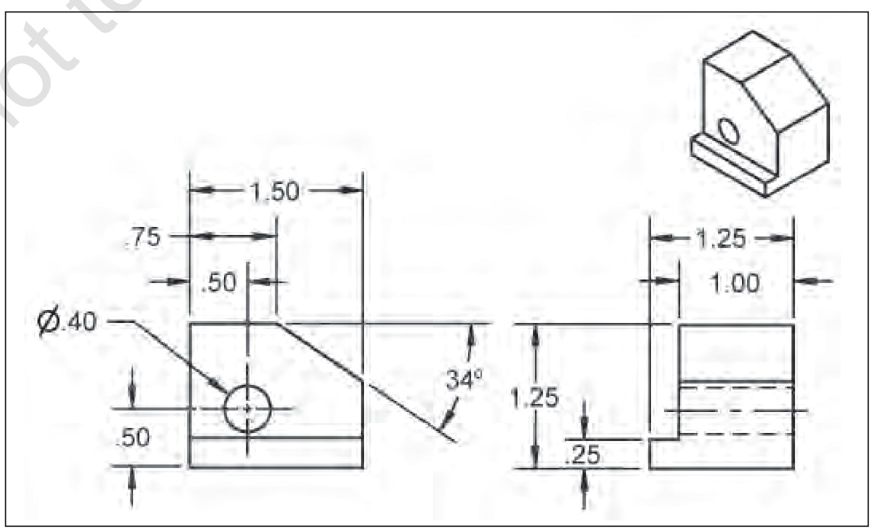


Fig.6.36: Dimensioning of 2-dimensional drawing

Drawing Sheet Layout

Standard layouts of drawing sheets are specified by the various standards organisations. Fig.6.37 shows layout of a specific drawing sheet, showing the drawing frame with title block, parts list and the space for orthographic projections.

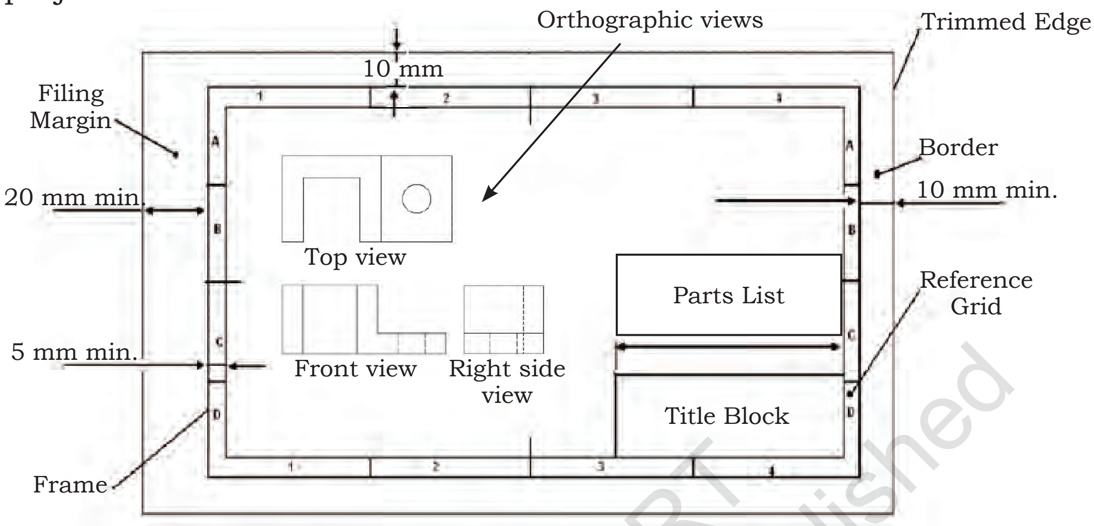


Fig.6.37: Layout of drawing sheet

Title Block

In engineering drawing, a Title Block is shown at the bottom right-hand corner.

The Title Blocks are written in simple way for better understanding. The following information should be added in this box.

Title Block is normally the:

- name of the firm/School/College
- name of the object (Work piece)
- number of the drawing
- format of the paper used (paper size)
- scale used
- dimensioning unit (usually millimetres --- mm)

The format of title block may vary. A typical title block is shown below:

Projection:	Scale: 1:10	Drawn: Kashiv	Remarks:	
	Dimension:	Group: Eng. & Tech		
	Date:	Checked: Saurabh		
PSSCIVE Bhopal	Name of Object: Knuckle Joint		Drg. No.	Format

Notes

Parts List

It is an essential component in any assembly drawing. It is generally drawn above the Title Block. The Parts Lists are shown also in the Title block. The width of the parts list is same as the Title Block, i.e. 180 mm. The height depends on the number of items to be included. The following information is usually included in the Parts List;

A. Part reference number
B. Name of the part
C. Number of parts required in an assembly
D. Material used to manufacture the part
E. Indication of standard or dimension
F. Drawing number

A	B	C	D	E	F
Ref. No.	Name of part	No. Reqd.	Material	Standard/ Dimension	Drg. No.

Spacing of Views

Spacing of views on drawing paper may be placed as such that the spaces between the views and the limits of the drawing space are roughly equal (horizontally and vertically).

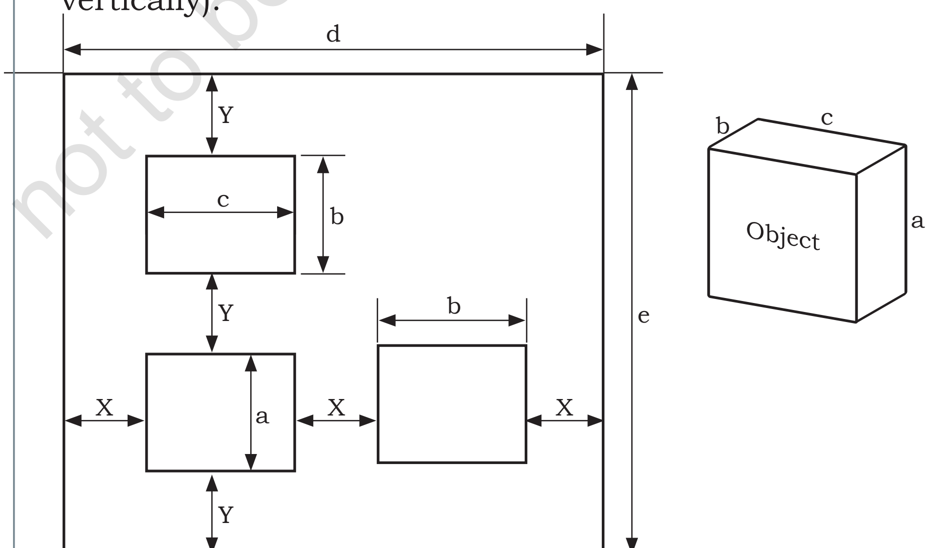


Fig.6.38: Spacing of views

Steps

1. Decide on the views to be drawn (i.e. front view, left hand side view and top view).
2. Determine the maximum dimensions of the various views to be drawn.
3. Determine the required space, based on the scale to be used, both along the horizontal and vertical directions.
4. Divide the "free space" into three equal portions, both horizontally and vertically. This determines X and Y as shown in the Fig.
   Horizontal Free Space = (Horizontal Drawing Space) – (Occupied Space) = d – (c + b)
   Horizontal spacing (×) = (Horizontal Free Space)/ (Number of Spaces) = {d – (c + b)}/3
   Vertical Free Space = (Vertical Drawing Space) – (Occupied Space) = e – (a + b)
   Vertical spacing (Y) = (Vertical Free Space)/ (Number of Spaces) = {e – (a + b)}/3

Reading Drawings

Technical drawings are used to visualise the product to be manufactured, built or assembled. A technical drawing explains shape, dimensions, and materials of construction and final shape of the material being created. For reading and understanding of a drawing, the Assistant mason needs to have some know-how of engineers and draughtsmen use dimensions, lines and notes to communicate the ideas on a sheet. They are imagined or drawn to help with the understanding the necessary information required to make and assemble an object regardless of its complexity. It is important that the assistant mason is able to read the drawings.

Steps for Reading Construction Drawing

1. Firstly, make sure it is the right drawing you are reading, see the name and part no. of the drawing.
2. Look at the Title Block on the drawing which is shown in the lower right of the drawing. The Title Block contains the information about the name of

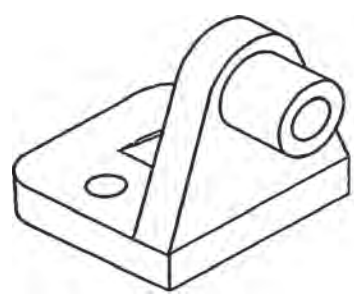


Fig.6.39: Construction drawing

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the person who has drawn it, checked it, name of the firm or the institute, drawing number, part number, projection angle and the scale of the drawing. This will help you to know the component's information.

3. There are different types of lines which are used in drawings. Each line has a specific meaning and it must be understood to interpret a drawing correctly.
4. Pictorial drawings are frequently used to show how an object should appear after it is manufactured. Pictorial drawings are used for simple objects.
5. For a more critical object, as shown in Fig.6.28, complete description in a pictorial drawing becomes very difficult to show. In this case, it is common practice to prepare orthographic drawings. These drawing are prepared to describe the object fully.
6. Orthographic drawings are made by parallel projections and include 2-dimensional multi-view drawings of the object. These consist of a front view, top view and the side view. Usually three views are sufficient to describe the project. However, any complex product may require as many as six views (top, front, left side, right side, back, and bottom).
7. Check the places of the views shown in Fig.6.40. Person should understand orthographic drawings. As per practice, the top view is placed above the front view and the right-side view is placed to the right of the front view. If additional views are needed, the left side is always drawn to the left of the front view and the bottom is drawn below the front view. Placement of the back view is flexible; it is usually drawn to the left of the left-side view. When understanding the different orthographic views, a pictorial sketch should be prepared.
8. In the drawing, dimensions of width and height of the object can be seen in the front view. The drawing of the top shows width and depth, and the side shows height and width.

9. Section views show the hidden features of an object so that a workshop technician can completely understand inside and outside details.
10. The dimensions provided in and around the projection views indicate measurements and the complete size. Usually, there are the projection and dimension lines.
11. Projections lines are drawn in alignment with edges of the object. Projections line are used to show the width of the indicated section.
12. Dimension lines are drawn from one projection line to another with arrowheads touching each projection line. Measurements are written on dimension lines to describe the size.
13. Look at symbols on the drawing. Identifying them is important when you are reading measurement.
14. Special precaution should be taken while handling the drawings. When drawings are not being used, keep them on a proper place or in another assigned place of storage. Drawings are integral part of construction and are difficult to replace if lost or damaged.

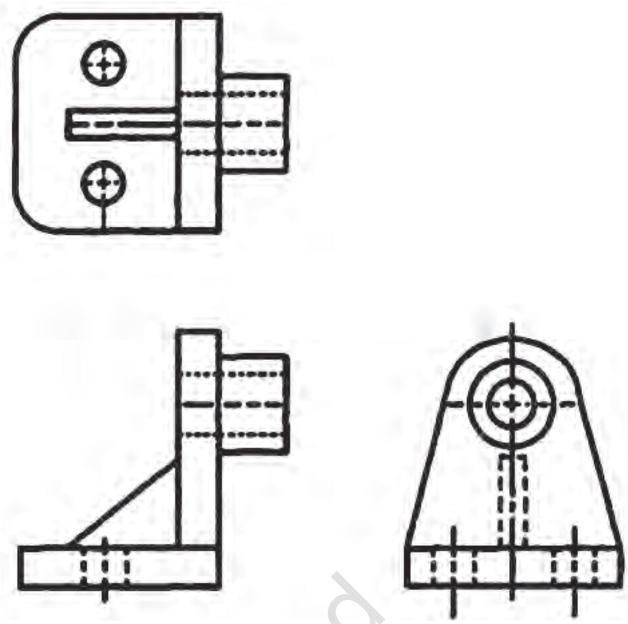

Fig.6.40: Orthographic views

Practical Activity

1. Make a list of drawing instruments used for geometric constructions

S.No.	Instruments used

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2. Prepare a poster showing six orthographic views of an object.

Check Your Progress

A. Fill in the blanks

1. A drawing is a __________ representation of a real object.
2. Engineering drawings do not portray the objects the way they __________ to the eye.
3. A scale has no __________ as it is simply a ratio.
4. The scale of 1:1 implies the object has been drawn to __________ size.
5. Hidden lines represent features that can not be seen in the __________ view.
6. __________ lines are drawn in alignment with edges of the object.
7. Line of sight is an imaginary ray of __________ between an observer's eye and an object.
8. Plane of projection is an imaginary __________ on which the image is created.
9. In isometric projection, all dimensions along all the __________ are drawn to __________ size.

B. State whether the following statements are true or false

1. An A4 paper size has dimensions of 297 × 420 mm.
2. Break lines are used to represent imaginary cut, so that the interior of the object can be viewed.
3. A scale of say 2:1 implies that the object has been enlarged twice its true size.
4. In diametric projection, all dimensions with two axes are drawn to true size.
5. In isometric projection, all dimensions along all the three axes are not drawn to true size.
6. Orthographic views help to record the shapes of objects exactly and completely.
7. A nonagon is a plane figure bounded by nine sides.

8. In the First Angle Projection the front view is the basis (reference) and the other views are drawn as 'shadows' of that view.
9. In every engineering drawing, a Title Block is included at the bottom right-hand corner.
10. Spacing of views on the drawing paper is not important.

C. Answer the following questions

1. Why are engineering drawings important in manufacturing and assembly?
2. What are the steps required for making engineering drawing?
3. What is the importance of scale in making engineering drawing?
4. Differentiate between and diametric and isometric projection.
5. Give the steps for reading engineering drawing.

Notes

Session 3: Building and Building Drawing

A building is considered as the three dimensional shape or form in the space, resting on the earth secured to the earth by foundation for stability. It consists of architectural space and structure for enclosing the space.

Planning, designing, drawing, estimating, construction, occupation, maintenance and preservation are various stages related to the buildings. Building drawing is a result of planning and designing for a specific type of building — it is a graphic representation by means of the shape and size of the proposed construction by means of lines, dimensions, notes, schedules, statement of areas etc.

Building Drawing

Drawing is the universal graphic language of architects and engineers. It has got its own grammar consisting of projectors and projections, orthographic and conical projections, use of different types of lines, symbols, abbreviations, dimensioning. The Assistant Mason is expected to have know-how to draw different views — plan, sections, elevations, read a drawing and use set

of drawings for estimating and construction purpose. Drawing is a tool to express all ideas about the proposed construction of building.

Building Plan

In building drawings, views projected of horizontal planes and observed from the top is known as a plan, shown in Fig. 6.41.

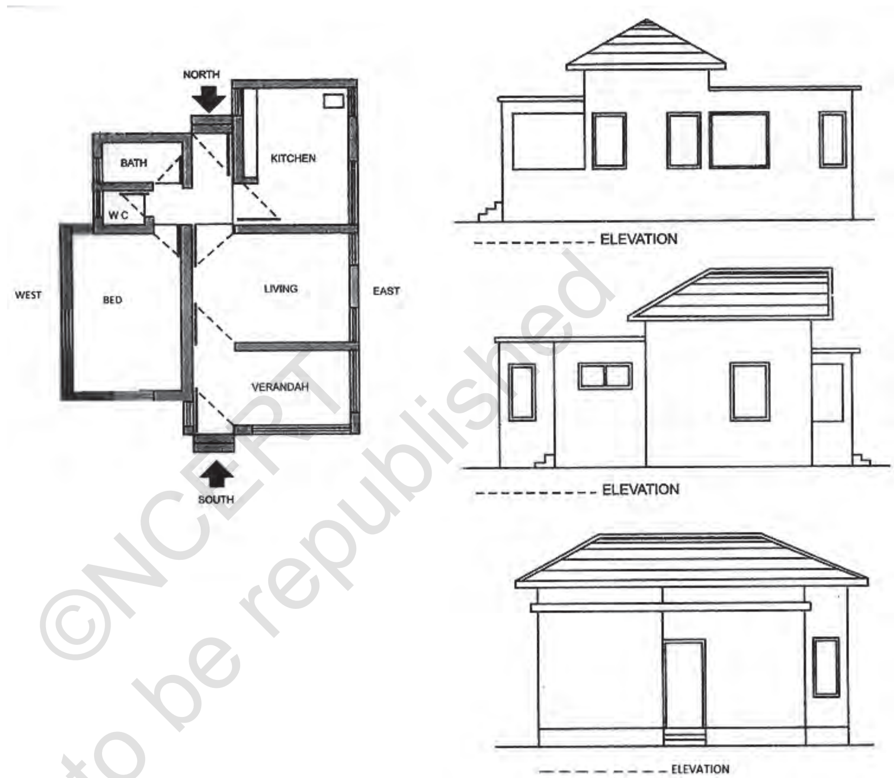

Fig.6.41: Plan and Elevation of Building

Elevation: Views projected to vertical plane, such as front size and rear view are called elevation. It is also termed as from elevation, side elevation and rear elevation.

Checklist for a Building Plan

Building plan should be checked with the list given below.

1. Dimensions the outside wall, rooms, passage, window and door and centre line, thickness of masonry, arrowheads for dimension line
2. Door, window symbols

3. Staircase
4. Floor level
5. Symbols for kitchen, sinks, WC bath, washbasin
6. Rooflines
7. Section lines
8. Built in cup board
9. Types for rooms
10. Floor finished schedule
11. Floor, plant, title and scale

Sections: In section, cutting plane or line has been drawn to give the internal details of the building vertically. It shows materials used, superstructure wall, plinth height, flooring, roof details, etc.

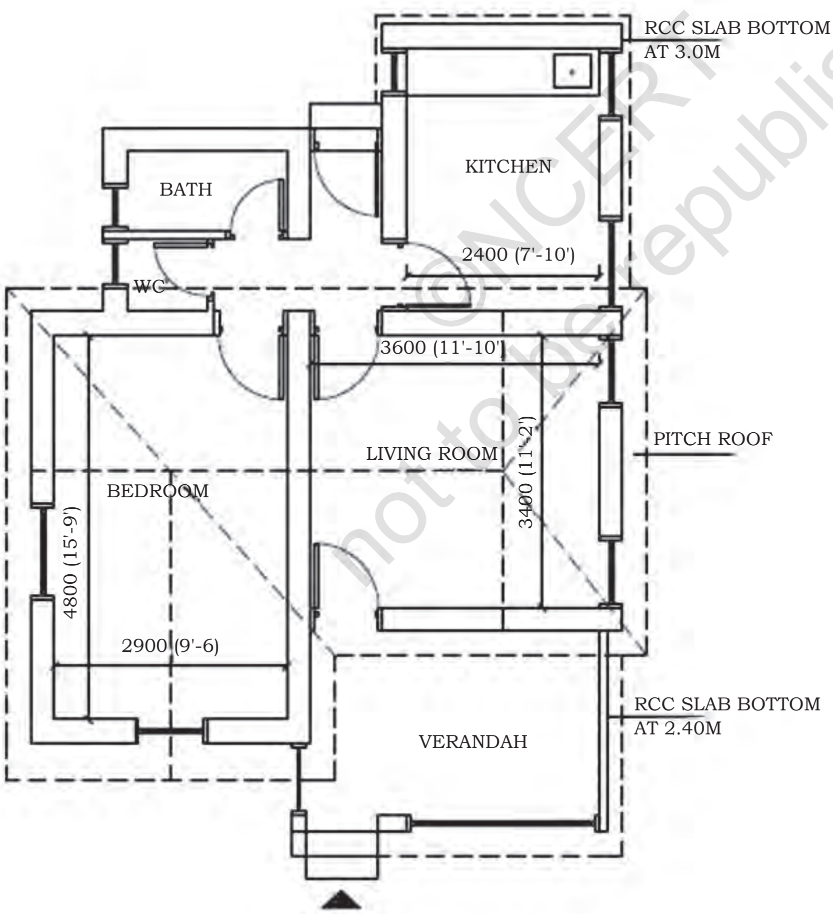

Fig.6.42: Sections

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Check Your Progress

A. Fill in the blanks

1. The size of A1 drawing sheet is __________ mm.
2. Tee square is used to draw __________ lines.
3. Compass is used to measure __________.
4. In third angle method projection, top view lies __________ of front view.

B. Answer the following questions

1. Explain different types of lines used in a building drawing.
2. Draw a neat sketch of the mini drafter.
3. Sketch the symbols for 1st and 3rd angle method projection.
4. Which points are to be noted in building plan, elevation and section?

C. Write short notes on

1. Building drawing
2. Set squares
3. Engineering drawing
4. Orthographic projection
5. Dimensioning